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A Study of the Relative Values of Nature-Study and Specific Instruction in Agriculture

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A STUDY OF THE RELATIVE VALUES OF NATURE-STUDY AND SPECIFIC INSTRUCTION IN AGRICULTURE

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BY

VIDA ALMEDA AUSTIN

B. S. Northwestern University, 1908

THESIS

Submitted in Partial Fulfillment of the Requirements for the

Degree of

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IN EDUCATION

IN

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THE GRADUATE SCHOOL

June 1, 1911

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

VIDA ALMEDA AUSTIN

ENTITLED A STUDY OF THE RELATIVE VALUES OF NATURE-STUDY AND SPECIFIC INSTRUCTION IN AGRICULTURE

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

W C Bagley
In Charge of Major Work

Head of Department

Recommendation concurred in:

Committee on Final Examination

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A STUDY OF THE RELATIVE VALUES OF NATURE-STUDY AND SPECIFIC INSTRUCTION IN AGRICULTURE

INTRODUCTION

With the recent tendency to make the nature-study work of the grades more narrowly economic and directly agricultural, the question arises as to whether in our tendency toward the utilitarian, we are giving the child the same opportunities for development which the broader field of nature-study offers. Is there here an equal opportunity for him to become more observing, as we believe he does become in the pursuit of the many problems in nature-study; will he be able to attack and work out problems as well after a series of strictly agricultural lessons as he would have been had these been more varied and general? It almost amounts to the question, are we justified in giving our work an industrial trend rather than considering it purely cultural?

Nature-study or elementary science is usually started in the primary grades and continues to the high school. It is the type of work suggested by Prof. Bailey,- broad, general, appealing to the immediate interest without special regard to the ultimate use of facts acquired. It seems quite generally conceded that this work shall become more economic in the grammar grades, as shown in McMurry's "Special Method in Elementary Science" and in the courses of study outlined for various schools. The theory is that while the subjects should have a utilitarian value in the grammar grades, the pupils are better prepared to attack the problems after having had the general outlook into the nature-study field.

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Agriculture is usually suggested for the grammar grades without any special nature-study preceding, as in the Illinois State Course of Study. Prof. Hodge in his "Nature Study and Life" urges that the topics throughout the grades shall be strongly economic. He says: "I have used them (economic values) because money is the common, universal expression of value that everyone understands and respects; and while we may realize that there are many things that money cannot buy, no other means of value is so fundamental to the ordinary affairs of life. Money value is, moreover, the trunk that supports many of the higher values. Some measure of assured material wealth must be attained before art, literature, and science can develop; and what holds true in the race, among different peoples, holds, in the main, with individuals. Further, the entire organization of society, social ethics, laws, and customs group themselves about this as the common measure of value for the life and work of man."[1] Some would teach agriculture as a form of industrial education, especially in the rural schools. Dean Davenport[2] expresses this opinion: "We must begin industrial education as early as possible, and agriculture is no exception. * * * Agriculture, even in the grades, is something more than ordinary nature study. It is nature study plus utility. It is nature study with an economic significance. It is nature study which articulates with the affairs of real men in real life. It is nature study in which the child may influence the processes. It is nature study which distinctly stimulates industry." Carlton[3] states the extreme opinion that, "Nature-study, agricultural physics, chemistry and economics, if taught in the public primary and secondary schools to students living on the

1. Hodge, "Nature Study and Life", page 18.
2. Davenport, "Education for Efficiency", page 139.
3. Carlton, "Education and Industrial Evolution", page 212.

farm, should answer the same purpose for this class of students which apprenticeship and continuation schools do for the skilled workers in shop and factory.

PURPOSE

This investigation was planned and carried through in an endeavor to determine what the pupils get from these two subjects, nature-study and agriculture, and thereby secure data on which to base an answer to the question of their relative values.

The investigation was suggested by Prof. F. L. Charles, Assistant Professor in Agricultural Education, and the plans were worked out and the teaching done under his immediate direction. The whole was under the general supervision of Dr. W. C. Bagley, Prof. of Education.

METHOD

Briefly the plan was as follows: to select two schools where the lessons could be taught under conditions as nearly natural as possible; give a preliminary test to both classes to learn the ability of the pupils when the experiment began; present a training series of nineteen lessons which should be nature-study in one school and agriculture in the other; give a final test to determine any difference due to the difference in the two training series.

The work was started in two ungraded rural schools in a neighboring county, and later a third was taken up. These schools were selected by the county superintendent, who understood thoroughly the nature of the experiment and plans and who gave valuable assistance in introducing the work into the schools and encouraging pupils

and teachers to make the most of the lessons. The schools chosen were as nearly alike as possible in respect of (1) the character of the neighborhoods, (2) the attitude of the patrons, (3) number of pupils; at the same time they were easily accessible from the inter-urban line, so that both could be visited on the same day.

In all schools in this county, the state course of study is followed so that all, except the 5th grade pupils, had had some instruction in agriculture. The only time allowed for it, however, was the general exercise period, which must also be used for the teaching of music, drawing, and morals and manners; hence not a great deal of time could be devoted to agriculture. After the work was started in the two schools, it seemed that the agriculture class quite overbalanced the nature-study in numbers, and that the teacher by his approval encouraged the pupils to do better work, whereas the other teacher was quite indifferent to it. A second class in nature-study was then started, making three schools in which I did the teaching. In this last case, the teacher was very enthusiastic, usually suspending his work in order to follow the nature-study. The other two teachers went on with their own recitations while I was having mine.

An attempt was made to have several other teachers in the same county teach from these plans and send me a report of each lesson, together with all drawings and written work done by the pupils. Only one teacher, (Miss B.) completed the series of lessons, but since this was in agriculture, it gives records of two classes each in agriculture and nature-study.

The classes were composed of 5th, 7th, and 9th year pupils, although the lessons were planned for 7th and 8th grade. It was believed, and proved to be true, that the work was a little

beyond the ability of the 5th grade pupils, but they were included because the teachers wished them to enter the classes and get whatever they could from the work.

Nature-Study

First Class	Age	Grade	Second Class (started later)	Age	Grade
A	14	9	E	16	7
*B	12	7	*F	15	7
C	12	7	G	13	7
D	9	5	H	13	7
			I	12	7
			J	12	5

Agriculture

First Class	Age	Grade	Second Class (Miss B's)	Age	Grade
A	16	9	*J	14	7
B	14	9	*K	13	7
C	14	7	*L	12	7
*D	14	7	M	13	5
*E	18	- 7	*N	12	5
F	13	5	*O	11	5
G	12	5	*P	10	5
*H	12	5	G	10	5
I	10	5	R	10	5
			*S	10	5

*Boys

In two classes	3 Boys 7 Girls	In two classes	10 Boys 9 Girls

In the two original schools, the preliminary test was given November 11 and I aimed to visit them twice a week, Tuesday and Thursday, but owing to irregularities due to vacations, county examinations and my other university work, the final test was not given until February 21. About fourteen weeks then were required for the giving of the twenty-two lessons. The second class in nature-study started December 20 and closed March 10, a period of eleven weeks.

Miss B's class started January 4 and closed April 17.

The agriculture class met, with one exception, at 9:10 a.m., the length of period averaging 27 minutes. Up to the twelfth lesson of the training series, the nature-study class recited during the last few minutes of the morning, beginning at 11:40, but afterwards it began at 1:30 p.m. The period here averaged 27 minutes. The interest and attention of the pupils seemed equally good at all periods, so that the time of recitation apparently made no difference. With only two or three exceptions, the second nature-study class met at 11:35 a.m., and the period of recitation averaged 29 minutes. Miss B usually had her class at 12:50 p.m. for an average period of 28 minutes.

One of the chief difficulties encountered in working out an experiment of this sort was that, while I started with large classes, attendance was so irregular that some of the pupils have not been included in the estimating of results since either the preliminary or the final test was missed. In two instances, the pupils were absent during the entire training series so that their test papers were not considered. The first of February, eight of the 7th and 9th year pupils moved from one district, which brought my agriculture class down from seventeen to only nine. I also found that I could not depend upon the class to prepare assignments, although it was usually done. I was absent from the school between recitations and the teachers were naturally more interested in their own work and sometimes neglected to remind the pupils of the assignments or to give them time for making drawings. This difficulty would be greatly lessened if the regular teacher also taught the nature-study (or agriculture).

It seems evident that it would not be practicable to

pursue the experiment further under similar conditions, for these interferences will invariably occur in rural schools; furthermore, some schools which would otherwise prove best for testing such a problem, must be avoided because they cannot be easily reached. Could the same experiment be tried in a town where there are two or more ward schools, I believe the results would be much more satisfactory not only because of fewer difficulties encountered, but because of the larger numbers of pupils and the greater uniformity among them in age and grade.

In the evening or the next morning after each visit, I wrote a report of the lesson, putting down as nearly as I could remember, the questions asked and the answers given. Any observations regarding the progress of the work or the ability of the various pupils were also recorded. Extracts from these reports occur through the following pages.

This same investigation was started last year but had to be dropped. At that time, two teachers in one county carried the plans through fairly well, the agriculture teacher completing the series and the nature-study teacher completing the fourteenth lesson of the training series. In these instances, I went to the schools and gave the preliminary tests and the first lesson of each training series, thus giving the teacher a demonstration in the presentation of such lessons, as well as having the opportunity to explain the plans more carefully than I could by writing, and giving her a chance to ask any questions. I visited the schools a second time to give the written review and present lesson XV. While I have no adequate records of this work, it seemed from my discussions with the teachers that this plan proved to be better than any other. The classes were both very enthusiastic and some of the pupils had been selecting and testing the seed corn for their fathers' spring planting. It was believed by Prof. Charles (of this university) that such a plan would be very feasible as a means of introducing nature-study-agriculture extensively into the schools throughout the state. If there were a few "demonstration teachers" who could go out and start the work in different schools, visiting them occasionally and giving assistance, the work would soon be quite generally taught, for the "unprepared" teacher would have some standard toward which to work. At the same time, the subject would be kept in the hands of the regular teacher who knows her pupils and patrons as a special teacher cannot, and she would not lose the benefits which inevitably result from the free intercourse with her

pupils which this subject offers.

PRELIMINARY TEST

All the pupils were given a preliminary test which had been worked out very carefully, so as to obtain as definite information as possible of the ability of each pupil. The test--a written one--was in two parts, but both were given on the same day with a recess of ten minutes between. The pupils were able to finish the first part in 25 minutes and the second in 20 minutes.

Following are the questions:

A- Answers to be written.

1. What do you use to kill "potato bugs"?

   Why or how does it kill them?

   Where did you learn this?

   Have you ever used this method?

2. What kind of cattle does your father own?

   Tell something about them.

3. Name as many reasons as you can think of why we should raise chickens instead of hawks.

4. If you were raising cotton and found your crop was small, most of the plants having few bolls, and the fiber usually very short, how would you plan to double or treble your crop within five years?

B- Desk work with material in hands of the pupils.

Twigs of American elm and soft maple.

1. Tell the name of the tree from which each twig came.

2. Examine the two twigs carefully. Write all the points in which one differs from the other.

3. Make a drawing of each.

4. Tell what you can of each kind of tree. (Here the pupils are told the name of each.) How abundant is it here? Of what uses are they? Tell where one of each is growing.

The county superintendent went with me the day this test was given and introduced the work both to the teacher and pupils. To the teacher I explained my plans in greater detail, but made no suggestion whatever that it was to be in the nature of an experiment. I was to be considered by him and by the pupils as a special teacher sent out by the University of Illinois to help them. To show how this test was conducted, I give below a portion of my report for one of the schools.

November 11, 1911.

Mr. M., the county superintendent, went to the school with me. When we reached there at 8:40, Mr. C. and a few of the pupils were there. Before school, Mr. M. presented the matter to the teacher, saying that I had agreed to come and give the lessons, but might possibly sometime ask his assistance in case I should not be able to complete the series of lessons which I had planned. He readily assented and seemed to be glad to have the work done in his school.

School was called at 9:00 and the first ten minutes were occupied with singing. At the close of this period, Mr. C. said that their visitors had something of interest to them which he would ask Mr. M. to present. Mr. M. spoke for about three minutes, first expressing his pleasure at seeing the improvements in the schoolhouse. He then presented the subject somewhat as follows: "How many have heard of the University of Illinois? Where is it? Have you been there? Miss A. comes from the University with some work which will be of interest to us. They have done a good deal of work there at the University but never until lately have they tried to do anything for the pupils of the public school. Miss A. has been doing some work down there in nature-study and she has some lessons prepared which she is coming out to present to you." Mr. C., to pupils,- "I assure you I am very glad to have you have this opportunity. You all know that I am very much interested in nature and heartily approve of having this work done in the school. Miss A. will take whatever time she needs now and the work this morning will probably give us some idea of what it is to be later." Miss A.,- "Today, I am going to ask you to write for me, so I will have a chance to learn your names and become a little acquainted with you. Mr. C. said he thought you would get some idea of what the work was to be, from the work this morning, but I am not so sure that you will."

Papers were passed and pupils were told to answer the questions as best they could,- to write something on each if only, "I do not know". Questions were read first and then written on the board, except the fourth. For the fourth question a brief description was given of the cotton plant. Most of the pupils worked very readily. All appeared to be doing their best. I went about and looked at their papers as they wrote, making suggestions, as,- "Can you think of any

other reasons? Have you written all you can think of? If you do not know, just write that you do not."

The first part of the test occupied about twenty-five minutes after the papers were passed. A recess of five minutes was given when all pupils went out of doors. Papers and materials were passed for the next exercise. The second part occupied just twenty minutes, finishing up rather hurriedly that we might leave at 10:15.

Two boys were absent.

An effort was made to make the presentation as nearly like this as possible in the other two schools. A list of suggestions so that the test would be presented to her class was sent to Miss B. under very similar conditions.

These papers were read very carefully and each graded on the following points, the numbers indicating the test questions on which the grades were based:

1. General knowledge. A - 1, 2. B-1, 4.
2. Observation. B-2, 3. Somewhat from A-1, 2.
3. Freedom of expression in writing. Whole paper.
4. Freedom of expression in drawing. B-3.
5. Reasoning. A-3, 4.
6. Initiative. A-3, 4.

TRAINING SERIES

The training series were planned to represent the two types of work or courses of study which have already been referred to. The series in agriculture was a single topic, the study of corn, worked out in detail--a typical economic study for the upper grades. The nature-study series consisted of a variety of topics to begin with, merely an introduction to the different lines of study which would be followed in much greater detail and to a greater extent by a class which had had nature-study throughout the grades. Following

these, were five lessons devoted to the same agricultural topic (corn) which the other class had pursued for the entire period of fourteen lessons.

It should be explained here, that the last five lessons, XV-XIX inclusive, on the study of the corn kernel, are identical in the two series. These lessons were originally planned to be the final test, but it was found to be very difficult to grade each pupil numerically on the same points as were used in the preliminary test, so for this reason, they were considered part of the training series, and a final test, similar in nature to the preliminary test, was worked out and presented at the close of the series.

The following represents in outline the character of the two training series:

Nature-Study Lessons	Agriculture Lessons
I. Preliminary Test	I. Preliminary Test
II. Training Series	II. Training Series
*1. General Field Trip	*1-13. Corn
2. Birds	14. Written Review
*3 and 4. Seed Dispersal	15-19. Corn Kernel
6 and 7. Dog	III. Final Test
8-13. Corn	
14. Written Review	
15-19. Corn Kernel	
III. Final Test	
*2 field trips	*2 field trips

The plans for these lessons as they were worked out before the experiment was started, are given here, complete. These were followed as closely as it is possible to follow plans in differ-

ent neighborhoods and under the varying conditions met with in a school room.

TRAINING SERIES IN AGRICULTURE

LESSON 1. PRELIMINARY

Discussion of corn and corn plant to bring out as many facts as possible. As points are developed, write summary on board somewhat as follows:

STALK	LEAVES	ROOTS
Height	Number	Number
Shape	Length	Length
Structure	Shape	Brace roots
	How joined to stalk	Area and depth in soil
TASSEL	**EARS**	**ENEMIES**
Shape	Location	Insects
Function (use)	Number	Birds
	Size	Ground squirrels (gophers)
		Wind and rain
		Smut

Raise as many questions as possible in this discussion, which must be left to be answered when material is at hand. For example: How is the leaf joined to the stalk? (Compare with maple leaf or geranium.) Is the stalk hollow all the way up? What is the structure of the joints?

(Teacher will find valuable information for her own use given in the lesson on CORN in McMurry's "Special Method in Elementary Science".)

LESSON II. FIELD TRIP

Visit a near-by corn field--with owner's permission--to obtain stalks which may be taken to the schoolroom to be studied in the next lesson. Answer as many as possible of the questions which arose in the first lesson. Have these questions in mind when the trip is taken. Give such terms as node, internode, sheath, blade.

Emphasize variation in size and strength of stalk, number of ears, height of ears on stalk, angle of ear on stalk.

LESSON III. STUDY OF MATERIAL

Make a careful examination for the purpose of answering any questions remaining, and discover any new points. Study the rain-guard ("ligule") and its use to the plant. Regard husks as modified leaves.

If the pupils are already familiar with the structure and function of flower parts, discover that the tassel is a group of staminate flowers which provide great quantities of pollen to be distributed by the wind; and that the young ear is a group of pistillate flowers, the kernel representing the ovary, and the silk representing the style and stigma.

If the pupils are not familiar with flower parts, develop simply that the pollen must fall upon the corn before corn--fruit--can be formed.

Why is the great quantity of pollen necessary? How do you account for an occasional ear in which there is a small number of kernels scattered over the cob?

LESSON IV. ADAPTATIONS

Develop (in note books) outline of observations made on the basis of adaptations--structures which fit the plant for some particular feature in its environment (surroundings). Let the pupils work out these discoveries for themselves. For example:

(1) Strength--solid nodes, pith, solid rind, short internodes at base of stalk, brace roots; long blade, parallel veins, wavy edges of leaves, flexible sheath.

(2) Moisture--rain-guard, deep roots.

(3) Heat and dryness--curling of leaves.

(4) Enemies--husks.

(5) Gravity--bending of stalk into upright position after falling.

LESSON V. ORIGIN OF CORN

Have we always had corn such as this? How long have we had it? Is it still changing? Where did it originate? Who first cultivated it? How did it differ from its present character? How could the present corn be developed from such a beginning? Do you know any men who are recognized as corn breeders?

Develop the idea of variation--the fact that no two corn plants or ears are exactly alike; heredity--the tendency of the plant to reproduce the character of its parentage; and selection--which the farmer makes in choosing seed which will produce as nearly as possible the corn that he wants. (He has an ideal in mind toward which he is constantly working.)

Name other plants similar to the corn plant--that is,

relatives of the corn. Importance of this group. The Grass Family--corn, sugar cane, wheat, oats, rye, barley, timothy and other grains and grasses.

Assignment--Study the first three pages in Farmers' Bulletin 229 - Production of Good Seed Corn.

LESSON VI. FIELD TRIP

Excursion to study stalks with reference to "desirability" Discuss, on the way, the assignment. Pupils will make the selection of desirable stalks. Lead pupils to see individual plants, with personal characteristics, rather than merely a field of corn.

Assignment--Pages 8 and 9 in Farmers' Bulletin 229. Each pupil to bring to school for next lesson at least two ears of corn which he considers desirable for seed. Also study "Explanation of points" on Illinois corn score card.

LESSON VIII. STUDY OF INDIVIDUAL EARS

Compare one ear with another and with standard as given on the Illinois corn score card. Give especial attention to length and shape of ear, selecting an ideal if possible.

Practice making measurements, such as length from extreme butt to extreme tip. Devise simple means for making such measurements quickly. Circumference with a tape line, taking the circumference measurement at a point one-third of the distance from the butt toward the tip..

Make a preliminary examination of the kernels.

Assignment--Page 10 to middle of page 13 in Farmers' Bulletin 229.

LESSON IX. STUDY OF EAR AND KERNEL

Butt--should be well filled, kernels uniform as far down as possible.

Shank--should be small, but sufficiently large to support the weight of ear.

Tip--rows should run well up to the tip, only a very little of the cob showing.

Kernels--carefully remove two kernels which stand side by side in the same row at the middle of the ear. Consider size, shape, uniformity, space between rows and between kernels at the cob.

Color of cob--should be red for yellow corn and white for white corn.

Make drawings of

(1) A good ear of corn.

(2) Cross section of an ear which has been broken at the middle, to show cob and spacing of kernels.

Assignment--Pages 13 to 17 in Farmers' Bulletin 229.

LESSON X. FIELD TRIP

Visit a neighboring farm to learn where and how the farmer has stored his seed corn. Learn what variety of corn he is growing. (In the small number of lessons here outlined we have not made provision for identification of different breeds of corn. This identification study might well be introduced here.)

Study his selection of seed. Select ears which might be used for an exhibit, on the basis of points already studied. Discuss uniformity of exhibit; the advantages of uniformity in seed corn. Point out that the ten ears of an exhibit may be uniform in a certain

character and still not standard as to that character.

Assignment--Pages 17 to 35 of Farmers' Bulletin 229.

LESSON XI. CORN JUDGING (CLASS EXERCISE)

Have pupils bring (or obtain from patrons of the school) exhibits of ten ears each. With score card in hands of each pupil judge an exhibit, all studying the same ten ears. Some of the points will need little discussion, having been developed in the preceding lessons. The process of scoring, however, will present difficulties. Let it be understood that this exercise is for practise and not an attempt at any high degree of accuracy. Uniformity, trueness to type, and vitality, or seed condition, will perhaps demand special attention here.

Assignment--Study of score card and practice in judging. (Doubtless in many cases the father of the pupil will be enlisted by this time.)

LESSON XII. CORN JUDGING (INDIVIDUAL EXERCISE)

Let each pupil work on his own exhibit, making (with minimum of help) his own observations, measurements and score. If necessary, let two pupils work at each exhibit. After the work is completed collect cards; compare and discuss results. (This work may not be completed in one lesson period, but there should be interest sufficient to carry it on outside of recitation time.)

Assignment--Review pages 10 to 23 in Bulletin 229.

(Note: Lesson X and XII were not taught as planned, but the study of the score card and class judging of two exhibits required the time of three lesson periods. The problem of selecting came up constantly through these lessons.)

LESSON XIII. RECITATION

Recitation on pages 10 to 23 of Farmers' Bulletin 229.

Management of the breeding plat.

Brief discussion of germination tests. (This will suggest materials for a series of lessons in the spring previous to planting time.)

Review and summarize entire process of production of good seed corn, somewhat as follows:

(1) Aim--To improve variety and increase yield.

(2) Means of accomplishing desired result.

Good stalks, good ears, good kernels.

(3) How produce such.

Discover variation.
Hold in mind an ideal.
Select always with reference to this ideal.

(4) Work of the corn breeder.

LESSON XIV. WRITTEN REVIEW

1. Tell the ways in which the corn plant is fitted for strength.
2. Tell how corn averaging two ears to the stalk could be developed from corn averaging one ear to the stalk.
3. Name the points on the corn score card.
4. (1) Draw a desirable shaped kernel.
   (2) Draw an undesirable shaped kernel.
   (3) Tell why (1) is better than (2).
5. Describe a perfect shaped ear of corn.

LESSON XV. PARTS OF THE CORN KERNEL

What substances are found in the corn that make it valuable as a food? By applying certain tests we may learn whether certain food materials (nutrients) are present in the corn kernel; but let us first examine the structure of the kernel, using yellow corn that has been soaked for a quarter of an hour in hot water.

From the outside, what parts can you discover? Observe the little cap which covers the tip of the kernel. (Sometimes it remains attached to the cob.) With a knife carefully break off this tip cap, as it is called. Now peel off the thin, tough covering, or hull. Notice the germ, consisting of a flat scale and a slender rounded portion lying within it attached at the middle and pointed at the ends. From this inner slender portion will develop the stem and the root. When the kernel was on the cob, did the germ face the tip or the butt of the ear? For convenience we will call the germ side of the kernel the front; the face opposite the germ, the back; the pointed end, the tip; the end opposite the tip, the crown; and the two narrow faces, the sides of the kernel.

Taking one of the soaked kernels, remove the hull--peeling it off with a knife--and examine the body of the kernel; is it of uniform appearance throughout? Describe what you see, having first looked at several kernels and having made sections of some. Test the different portions with the point of your knife. Find a hard, yellow, or horny part and a white portion. Make sections crosswise and lengthwise to discover the distribution of white and yellow in the kernel.

Make an enlarged sketch of the kernel (three times natural size) and indicate the parts we have identified--hull, tip cap,

germ, horny part and white part. Do all of the kernels which you have examined show the same distribution of parts and the same relative amounts of each? Examine kernels from different ears of corn to learn whether the relative amounts of white part and yellow horny part are the same in all cases. What does this division into yellow and white portions signify to you? (Possibly different composition, or different food substances.)

For our next lesson we will make tests to discover the chemical composition of the kernel, or to learn what food substances (nutrients) are present.

Assignment--Make drawings (three times natural size) of (1) a cross section of a kernel through the middle, a longitudinal section through the middle of a kernel as it lies on its back, and (3) a section of a third kernel cut so as to divide it into two thin flat halves. In each sketch, label the tip, crown, germ, white part and horny part.

LESSON XVI. TEST FOR CHEMICAL COMPOSITION

Here is a solution of iodine. Placing a drop of the liquid on a lump of sugar, or on a piece of butter, we see no striking effect. Now let a drop fall on a lump of laundry starch, or on some corn starch; what effect? (The starch "turns blue".) Try other substances, such as tissue paper, glazed paper, soft cloth, and starched cloth. Iodine reveals the presence of starch by turning the substance blue. Since it acts in this way upon nothing else it is called a test for starch, or the "starch test". Let the pupil now make a complete statement concerning the starch test.

Now test corn for starch, using a kernel which has been

soaked for a few minutes in hot water and from which the hull has been removed. (Note: there is a thin layer of gluten over the surface--under the hull--which we did not discover in our previous lesson, and which may prevent the iodine from reaching the starch. Hence it is well to scratch the surface of the kernel, or to peel off a thin layer (next the hull) before applying the iodine. The best results will be ovtained by applying the iodine to the cut surface of sections made as directed in the previous lesson.) Try the iodine also upon bean, oat, and sliced potato (raw), scratching the surface of each to allow the iodine free access to the starch grains.

After this demonstration by the teacher, let each pupil make the three kinds of sections, from three different kernels, and test each to learn where starch exists. (To the teacher: such sections are shown in Plate 4, Page 95, of Bulletin 87, Illinois Experiment Station.) Now show in enlarged drawings the results of the test, indicating the blue portion by colored pencil or by shading. (This work can be made the assignment for the next lesson.)

Can you now recognize the position of the starch without using the iodine? How? (The white portion proves to be the starch. The hard, yellow, horny part, which does not take on so blue a color, contains a large amount of starch but also considerable material that is not starch. There seems to be no starch in the germ.) Where in the kernel is the greater part of white starch--in the tip or in the crown? Are all kernels alike in relative amounts of tip starch and crown starch? Look at kernels from different ears to answer this question.

LESSON XVII. FURTHER TESTS FOR CHEMICAL COMPOSITION

Let us examine the germ. With knife remove the germ from the kernel and lay it on a piece of paper. Does its appearance suggest the presence of any familiar substance? Crush it on the paper; what effect? (It leaves a "grease spot".) What does this suggest? This spotting of the paper is one of the tests for fat or oil. Four-fifths of all the oil in the kernel is contained in the germ. Name other sources of fat or oil in our food. (Fat meat, butter, cream, lard, olive oil, the oil in nuts, etc.)

We have now discovered two food substances (nutrients) in corn; namely, starch and oil. A third very important nutrient, necessary to all animal life, is protein, which is abundant in lean meat, white of egg, cheese, peas, beans and many other foods. Let us see if we can detect protein in the kernel. For the protein test nitric acid and ammonia are used. (The teacher will demonstrate this test for the class.)

From kernels which have soaked over night--or at least several hours--cut three kinds of sections as before. On the cut surface place a drop of nitric acid, allowing it to remain a few moments; then wash it off with water and put on a drop of ammonia. If present in much quantity, a bright yellow color will appear. Where does the protein seem to be, according to the test? It is found chiefly in the horny gluten, a thin layer just beneath the hull (as mentioned in the last lesson) for which you must look closely, and the horny yellow part which we have noticed as dividing the white starch into two portions, tip starch and crown starch. This "horny starch" may not show the starch test very clearly, since it is so largely made up of protein. Where does the yellow, or horny, starch chiefly lie? (At the

sides and back of the kernel.) Make drawings to show the distribution of protein in the kernel.

Note: For the next lesson the teacher need not require any reading, but she may suggest to the class that on pages 80, 81 and 82, and in Plates 1 and 2, of Bulletin 87, will be found helpful material in studying the structure of the kernel.

LESSON XVIII. SELECTION AND BREEDING BASED ON KERNEL COMPOSITION

What three nutrients have we discovered in corn? Where was the oil? (In the germ.) What sort of a kernel will contain a great deal of oil? (One which has a large germ.) Where was the starch? (Chiefly in the white portion, but partly in the horny portion of the body of the kernel.) Where was the protein? (In the horny gluten just under the hull and in the horny starch.) If a kernel is richer than usual in starch (white part) how much protein will there be? Less than usual; if there is more white starch there cannot be so much horny starch (which contains a large amount of protein). If a kernel contains more protein than the average--such being known as "high protein corn"--there will be relatively less starch, for high protein corn contains not only a thicker layer of horny gluten, but also a greater proportion of horny starch, thus reducing the amount of white starch. To summarize--high protein corn is low in starch; low protein corn is high in starch; a large germ means high oil content. Look again, if necessary, at kernels from different ears to discover the range in composition and relative amount of oil, protein and starch.

For what is corn used other than as food for man and

animals? (It is used in making oils, paints, soaps, whiskey, gum, sugar, syrup, rubber, starch, and many other products.) Would all parts of the kernel be wanted in making any one of these products? What kind of a kernel would be preferred by a factory where starch is made? Where oil is prepared? Where hominy is prepared? (High protein corn is preferred for hominy.) Do you think that the kind of corn that comes to these different factories is an important matter to them? (Yes, it is.), Furthermore, high protein corn is more valuable as food for stock than is corn with little protein.

Do you suppose it would be possible for us to deliberately increase the relative amount of oil, starch, or proteid in our corn? How could we do it? (Possibly the pupil will suggest selecting kernels for seed which are high in protein, high in starch, or with a large germ. If this is not suggested proceed with questioning.) Could we determine in advance what kind of corn we would grow as regards relative amounts of these nutrients? Yes, we could examine our seed corn; by means of the tests we have been using, or merely with the knife to observe the structure of the kernel, and then use for seed only that kind of corn which we desire to grow.

Could we really create a new breed of corn which would be richer in protein, for example, than any breed we have yet seen? How? (By selecting seed in this way, and repeating this selection year after year, until the average amount of protein has been permanently increased.) Note to teacher: If this answer is not readily given, ask what was learned in our lesson on the origin of modern corn from primitive Indian maize. Recall the facts of <u>variation</u>--no two specimens are exactly alike; <u>selection</u>--picking out for seed the kind that suits us best; and <u>heredity</u>--the tendency of next year's crop to be like the seed from which it was grown. If the process of

improving the breed seems to have been well learned from the previous lessons, recall them here as illustrating the same principles.

Do you know whether such breeding for protein--or for oil, or for starch--has ever been done? (Yes, the Experiment Station at Urbana has accomplished much in this direction. If you care to learn what has been done there, read pages 92-94 and 110-111 in Bulletin 87.)

LESSON XIX

WRITTEN REVIEW OF LESSONS XV TO XVIII INCLUSIVE

1. Name the three nutrients found in the corn kernel.
   In what part of the kernel is each?
2. Describe the starch test, telling,-
   (1) What we used for the test.
   (2) What we did with it.
   (3) What happened.
3. Draw a longitudinal section, through the broad way, of a kernel of corn high in protein; of one low in protein.
4. How did we determine that there was oil in the kernel?
5. Tell how a man raising corn mostly medium in protein could in a few years develop high protein corn from it.

TRAINING SERIES IN NATURE-STUDY

LESSON I. EXCURSION FOR NATURE NOTES

Brief discussion of nature conditions,- weather, trees, flowers, seeds, farm activities. Just when did you see the last blackbird, robin, cabbage - butterfly, gopher, snake? What do these animals do as winter approaches? When was the first frost? Was it earlier or later than usual? Is it important to know about when the first frost will come? Let each one make daily records of his observations in a "Nature Note Book",--weather, birds, farm activities, etc.

Take the class on a trip along the roadside or into woods, wherever the greatest variety of observations may be made. Have scratch paper and pencil so that records may be made. Have such questions in mind.--Are there any flowers in bloom? (If it is a warm day with no snow on the ground, you may find dandelions.) Where are they? What were the last ones you saw? Why are these left? (Hardier than most flowers; perhaps in sheltered place or on a sunny slope.)

How many trees can you name by sight? Can you describe the peculiarities of each? Point out a particular tree near by and observe its general outline, branching, and bark. Select out typical individuals of some of the common trees in your neighborhood and suggest that the pupils become well acquainted with them. There is much to be studied on the twig later, for it may also be used in identifying the tree.

Seeds and fruits (fruits here meaning the entire product of the flower). Which ones are being scattered now?

What birds can we see and hear? How do you recognize them? What are they doing? Watch especially for birds between now and the next lesson. Record those which you see, with dates of observations. (Identify, if possible, English sparrow, bluejay, crow, screech owl, "chicken hawk", downy woodpecker.)

LESSON II. BIRDS

Read lists of birds observed. Why so few? Why did others leave? ("On account of the cold?") Have these birds which you have been seeing any more protection against the cold than those which have gone south? (Food is the main problem). Then how could these birds survive in winter? (Their food is such that it can be obtained at almost any time during the winter,--seeds, fruits, insect eggs and larvae.)

Where does the woodpecker obtain its food? What kind of food does it find there? Where does the English sparrow get its food? And what sort of food is it? Could the sparrow obtain its food as does the woodpecker? Why not? How is the woodpecker equipped for food getting? (Long, strong, pointed bill; long tongue with rasp-like edge; toes arranged in pairs, two pointing forward and two backward; tail feathers very stiff and pointed,--used as a brace.)

What provision has the sparrow for obtaining its food? (Short, thick bill for breaking seeds.) The hawk? (Strong curved talons for capturing and holding its prey: sharp curved beak for tearing.) What clue have you (in the form of certain birds) as to where to look for them? (Since they have special structures fitted to obtain special kinds of food, we look for the birds where the

special kind of food is to be found. For example, we may expect to find sparrows (short, crunching bill) in weed patches; long-legged, long-necked birds, about the waters, etc.

The place where the bird is commonly found, and its customary actions are helps in identifying it. What other means are there? (Song or call, flight, plumage.) Can you describe accurately the plumage of the English sparrow? The downy woodpecker? Watch for the winter birds and learn to know them well, so that in the spring we may give our attention to those which are returning from the south.

LESSON III. TRIP TO STUDY SEED DISPERSAL

On our field trip the other day, we noticed that some of the plants still retained seeds. What is the use in a plant's producing seed? (So that more plants of the kind may grow up. The whole life and work of plants is mainly to produce seeds.) What becomes of the seed? Do they fall directly below the plant? Can you see any disadvantage in their dropping down in this way? (Too many to grow in such a small space. They are more likely to have a chance to live if they are scattered.) There are several different ways which seeds have of being scattered which we may easily discover. Can you name any way? Our class time today will be spent out-of-doors determining what these are. (If the class has had a study of seed dispersal, this trip will be, not to determine what the ways are, but to determine to which group different weeds belong.)

Make this in reality a trip of discovery for the pupils. Go over the ground first, yourself, so that you will know just what the class will find and no time will be lost in searching for types. Proceed by questions, as:- "What is this weed? Do you find the seed?

How may they be distributed? Find other plants whose seeds would be similarly scattered."

Determine the four types, if possible, with several examples of each. Have pupils write these in groups in their notebooks, making additions to the lists any time later.

1. Those carried in animals' coats, on people's clothing, as: burdock, Spanish needle.
2. Carried by wind: dandelion, thistle, milkweed, wild aster.
3. Shaken out by swaying of stiffened stalk: evening primrose, mullein.
4. Edible fruit with indigestible seeds: wild grapes, woodbine (five-leaf ivy), green briar.

At the close of the period, call attention of the class to the velvet weed (butter-print). Do you know this weed? Do farmers like to have it in their fields? Why not? For the next lesson we are going to study this weed carefully, so in the meantime, find out all you can about it. Examine it, ask your father or neighbors to tell you what they know of it, if it does any damage, what they do to get rid of it, if they do anything. Each pupil bring to class a specimen of the plant, entire.

LESSON IV. STUDY OF VELVET LEAF (BUTTER-PRINT)

Each pupil should have a specimen to examine and use during the lesson. Where does this weed grow most commonly? (In plowed ground.) How does it become so abundant, as it sometimes does? (Seeds are scattered and new plants grow up.) Do you find the seeds? Where are they? How many seeds does a single plant produce? If the class has had work before in estimating the number of seeds produced

by a single plant, this need not be done here. If they have not had such an experience, select an average seized plant and let the class work on it, getting an estimate of the number. Different ones may determine average number of seeds in each cell, number of cells to a pod, number of pods to a branch, number of branches on a plant. These multiplied together will give about the number on the plant. Do not spend too much time on this, go over it rather hurriedly. On a good sized plant recently studied there were found to be about 2625 seeds. If this plant had been left in the field, what might it have meant next year? (Nearly that many young plants.)

Is the plant of any use? (No, not as we find it, but it may someday be grown for the tough fiber in the bark, just as hemp and flax are now grown.) Let the pupils see this fiber.

Does it do any damage? (Takes moisture and food from the ground which the crops need. Takes sunlight, shading smaller plants.)

Since it is of no use and is harmful, we must try to get rid of it. What are some of the means employed to destroy it? (Destroyed by cultivation, dug up, pulled up by the root, cut off, burned in the fall). When should they be destroyed? (Before seeds are ripe).

Does this plant have any other means of producing new plants than by seeds? (No, it is an annual.) It is rather easy to get rid of this plant then if taken at the right time. Some plants are not so easily destroyed, for if the top is cut off it grows up again. Burdock, wild parsnip and others form a large root the first year and send up the flower (or seed) stalk the second year. What is such a plant called which lives two years? (Biennial.) There is still another group which lives several years. (Perennials.) These

are much harder to destroy. Canada thistle and quack grass are examples. These have an underground stem which grows off from the main plant and keeps sending up new plants, these taking root and forming underground stems, and so spreading. Means of destroying: digging up in dry weather; smothering crops (clover, millet); if very abundant, sprinkling with salt or spraying with kerosene, or acid solutions are used. (These are used for annuals or biennials.)

Assignment:
Make drawings
1. A stalk of velvet leaf with several pods
2. Side view of a single pod
3. Top view of pod
4. Seed (twice natural size)

LESSON V. TWIGS

Arrange in advance that pupils shall bring twigs from trees: American elm, soft maple, box elder, cherry, cottonwood, etc. Briefly consider various means of distinguishing each, as by bark, buds, leaf scars. Select American elm and soft maple for special study. (Provide material sufficient that each pupil may have a twig of each.)

BUDS--Size and Shape--Are all buds on one twig of the same size? What comes from one of these buds? (Answer may be "leaves".) How many leaves from one bud? A whole twig grows from most of them. You may be able to find flower buds on the elm, the flower buds being larger than the twig buds.

Color and Covering--(Scaly in both of these.) Notice the sticky covering on the poplar buds. Use of such covering. (Not to prevent freezing, but to protect from moisture and from sudden changes, rapid freezing and thawing, which are very injurious. Also may

protect from injurious insects and other tree pests.)

Are these features characteristic of all, or most twigs from the same kind of tree? The bud itself may be a means in identifying trees.

Arrangement--Compare elm and maple as to arrangement of buds on the twig. Buds of maple are in pairs. What term may be used for the elm? Use a string to show that the arrangement is spiral. Start a string at the first bud and twist it around the stem in such a way as to touch all buds successively.

If we were to draw straight lines lengthwise of the twig through the buds, how many such lines would there be? Buds of the elm are arranged spirally in two rows, buds of the maple are paired and in four rows. (The willow, poplar, cherry, oaks and others have five rows, the arrangement being spiral. These need not be discussed now.)

LEAF SCARS--Can you determine where the leaves were this fall? What evidence do you find? (Leaf scars immediately below the bud; note point where leaf stalk joined the twig. Confirm this observation by finding some twig to which the leaf still clings.) What trees hold their leaves longest? (Examine fruit trees and the scarlet oak.) Then what is the leaf arrangement of the elm? Maple? (Same as the bud arrangement.)

Assignment--Draw an elm twig and a maple twig and see if you can make better drawings of them than in the first lesson. Keep in mind the relative size and shape of buds.

LESSON VI. THE DOG

While we have been giving our attention to outdoor conditions and wild life, there are just as many things to be learned about our common plants and animals on the farm.

Have there always been domesticated animals as we see them today? Where did they come from? (Originally from wild animals.) How long have they been domesticated? (Some as far back as we have any historical records.) Which was first to be domesticated? (Dog) When? (Before the beginning of history.) From what? (Some form of wolf.) What are the living wild relatives of the dog? (Wolf, fox, jackal.)

Why should primitive people wish to domesticate wolves? What uses did they make of them? (Hunting at first; perhaps as playmates; later as watch dogs.)

What characteristics of the dog fit him to serve man? Physical--keen sight, scent, and hearing; form of body and legs; teeth. Mental--loyalty; intelligence, companionableness. Are our dogs like those the ancient people had? How are they different? (Many more kinds now, some with characteristics very different from the wolf-like dogs.) What kinds of dogs do you know?

Assignment--For the next lesson, each one write a list of the kinds, or breeds, of dogs which you know, classifying them by uses. For example: for hunting--greyhound, beagle, setter, pointer; watch dogs--collie, bulldog; pets--terriers, poodles. Also bring pictures of as many kinds as possible. (These may often be found in advertising sections of magazines or in newspapers.)

LESSON VII. HOW DIFFERENT BREEDS ARE DEVELOPED

Brief report of lists of kinds of dogs and their uses. Discuss and compare pictures to determine distinguishing features of the different bfeeds. (Have dog pictures hung about the room for a few days and let each pupil paste his own, if they may be cut out, into his note book.)

How did we come to have so many kinds of dogs when all have descended from wolves? To how many uses were dogs first put? Does that suggest an explanation? No two dogs are exactly alike; some are fitted for watch dogs but not for hunting. Each individual tends to have the traits of its parents, and so characteristics are passed on through generations. Perhaps there was one man who wanted dogs for hunting, so any that could not hunt he disposed of, thus constantly selecting those that best suited his idea of a good dog until he had many dogs that were good hunters. At the same time another man may have wanted watch dogs and selected with that in mind; his idea of a good dog was one that had a powerful body and sharp teeth, it making little difference whether he was a good runner or not. There were other men with different ideas and so there came to be many kinds or breeds of dogs.

The whole process depends upon (1) variation among individuals, no two being alike; (2) selection, which the owner makes generation after generation so as to have dogs constantly like his ideal; and (3) heredity, the tendency of the offspring to reproduce the character of its (selected) parentage. Thus breeds are developed at will.

LESSON VIII. STUDY OF THE CORN PLANT

Brief description of corn plant, bringing out the following points: structure of the stalk; how the leaf is joined to the stalk; distinguish brace roots; area and depth of roots in the soil; flowers of two kinds--on the tassel, the staminate, furnishing pollen-pistillate flowers on the cob; the kernel is the ovary, silk is the style and stigma. (If flower parts are not well understood, bring out simply that pollen from the tassel flower must fall on silk of cob flowers before the kernel can develop.)

Study of stalks which the pupils have brought in as specimens of good stalks. Compare with undesirable stalk which you have brought. What are the features of a desirable stalk? Make use of such terms as node, internode, sheath, blade. Study the rainguard ("ligule") and its use to the plant. Regard husks as modified leaves.

Why is a great quantity of pollen necessary? How does pollen reach the silk? (Carried by wind.) How do you account for an occasional ear on which there is a small number of scattered kernels?

During the discussion, think of adaptations in the various structures and work out a classification of them for the notebooks. (Write on the board as points come up and let pupils copy later.)

ADAPTATIONS:

1. For strength--solid nodes, short internodes at the base, brace roots, long blades, parallel veins, wavy edges of leaves, flexible sheath.
2. For moisture--rain guard, deep roots.
3. Heat and dryness--curling of leaves.
4. Enemies--husks.

5. Gravity--bending of stalk into upright position after falling.

Have we always had such corn as this? How long have we had it? Is it still changing? Where did it originate? Who first cultivated it? How did it differ from its present character? How has it been developed? Variation, heredity, and the selection which the farmer makes in choosing seed which will produce as nearly as possible the corn that he wants. (He has an idea in mind toward which he is constantly working.)

Name other plants similar to the corn plant--that is, relatives of the corn. Importance of this group, the grass family--corn, sugar cane, wheat, oats, rye, barley, timothy, and other grains and grasses.

Assignment--

Make drawings of

1. Entire Plant.

2. Portion of stalk showing two nodes, a sheath and especially the details of the rain-guard.

LESSON IX. TRIP TO STUDY SEED CORN

Give out Illinois Corn Score Card.

Visit a neighboring farm to learn where and how the farmer has stored his seed corn. Learn what variety he is growing.

How does this corn differ from the corn which has been put in the crib? In what ways is it better? Are all ears alike? Discover if possible what features the owner had in mind when he selected this corn for seed. Afterward perhaps he will tell the class what he is working for. Bring out points of desirable ears

(as given in Farmers' Bulletin 229 and on the Illinois Corn Score Card)--shape, length and circumference; shank small but sufficiently large to support weight; rows straight and close together, but with space enough to allow air to circulate so that ear may dry out; kernel rows run well up over tip, only a little cob showing; butts well filled; cob red for yellow corn, white for white corn.

Assignment--to page 10 in Farmers' Bulletin 229. Also study explanation of points on Illinois Score Card.

Each pupil bring to class two ears which he has chosen as desirable. Ask parents for help in learning to recognize good ears and to judge corn.

LESSON X. STUDY OF INDIVIDUAL EARS

Briefly summarize points of desirable stalks, ears and kernels as given in Farmers' Bulletin 229.

Study of individual ears--compare one ear with another and with a standard as given on the score card. Practice making measurements, length and circumference. Devise simple means for measuring quickly the length from extreme butt to extreme tip. Measure circumference with a tape line at a point one-third of the distance from the butt toward the tip.

Carefully remove two kernels which stand side by side in the same row, at the middle of the ear. Consider size, shape, space between rows, space between kernels at the cob. Uniformity.

Make drawings of

1. A good ear of corn.
2. Cross section of an ear which has been broken at the middle to show cob, and shape and spacing of kernels.

Assignment--Pages 10-17 in Farmers' Bulletin 229.

LESSON XI. CORN JUDGING (CLASS EXERCISES)

Have pupils bring (or obtain from patrons of the school) exhibits of ten ears each. With score card in the hands of each pupil judge an exhibit, all studying the same ten ears. Some of the points will need little discussion, having been developed in the preceeding lessons. The process of scoring, however, will present difficulties. Let it be understood that this exercise is for practice and not an attempt at any high degree of accuracy.

"Uniformity" will need to be discussed; the advantages of uniformity in seed corn when it is desired to establish a type which will breed true. Point out that the ten ears of an exhibit may be uniform in a certain character and still not STANDARD as to that character.

Vitality, or seed conditions, will need consideration. (If the teacher feels that she has not sufficient information to carry this very far, look simply for vigor of the germ.)

Trueness to type can be judged only if the variety of the exhibit and the variety characteristics are known. It will be just as well to use the standards for unnamed varieties. Proportion of the shelled corn to the ear should be discussed but need not be demonstrated.

Assignment--Pages 17-23 in Farmers' Bulletin 229.

LESSON XII. CORN JUDGING (INDIVIDUAL EXERCISE)

Let each pupil work on his own exhibit, making (with minimum help) his own observations, measurements and score. If necessary, let two pupils work at one exhibit. After the work is completed,

collect the cards; compare and discuss results.

(Teacher by planning in advance can obtain help in judging from any scientific farmer who has been in touch with the Farmers' Institute.)

Assignment--Review pages 10-23 in Bulletin 229.

(Note: Lessons Ix and XII were not taught as planned, but the study of the score card and the class judging was spread out through three lesson periods. The problem of selection came up constantly through these lessons.)

LESSON XIII. RECITATION

Recitation on pages 10-23 of Farmers' Bulletin 229.

Management of breeding plot.

Brief discussion of germination tests. (This will suggest materials for a series of lessons in the spring previous to the planting time.)

Review and summarize entire process of production of good seed corn, somewhat as follows:

(1) Aim--to improve variety and increase yield.

(2) Means of accomplishing desired result.

Good stalks, good ears, good kernels.

(3) How produce such.

Discover variation

Hold in mind an ideal.

Select always with reference to this ideal.

(4) Work of the corn breeders.

LESSON XIV. WRITTEN REVIEW

1. Name three groups of dogs according to use.
   Name three kinds belonging to each group.
2. Tell how the woodpecker is fitted to obtain its food.
3. Tell how corn averaging two ears to the stalk could be developed from corn averaging one ear to the stalk.
4. (1) Draw a desirable shaped kernel.
   (2) Draw an undesirable shaped kernel.
   (3) Tell why (1) is better than (2).
5. Describe a perfect shaped ear of corn.

LESSONS XV TO XIX. STUDIES OF THE CORN KERNEL

These lessons were the same as the corresponding lessons in agriculture and are given with the Training Series in Agriculture.

Extracts from Reports in

AGRICULTURE *

LESSON II

November 17, 1910.
Cloudy, N.W. wind, quite cold.
Absences - (3 boys)

Class started at 9:10 and I reminded them that we would spend our class time in Mr. McL.'s corn field across the road and try to answer some of the questions which came up in our last lesson. No one had tried to answer them by a study of the material. The class passed quietly into the hall and they quickly got on their wraps. We ran down the road a short distance to the gate and into the field so as little time as possible was wasted. Each one selected a hill on which to make observations. So as to work as rapidly as possible, I asked questions and each would refer to his stalk or stalks for the answer. The class being so large (14 today), I was not always sure that each had a chance to give his results. For general questions, I did not call on particular pupils, but asked anyone to speak up. All paid close attention to the work. Three girls seemed to answer more than the others. The boys were very quiet, one of them talking more than the others.

I gave them the term node and they were able to suggest the prefix inter to form the word internode. I also gave them the word sheath. Blade had been suggested in the last lesson.

The following are the parts determined:

Stalk, 6-10 feet high, mostly 8 feet.
-tapering toward the top.

Internodes, 4 inches at base, 8 inches at top.

Leaves, 11-13 on a stalk.

Ears, 1-3 on each stalk.
-at 7th or 8th node.
-if more than 1, on successive nodes.
-height from ground, 2-5½ feet.

Roots, from internodes above ground, to brace the plant.

Several stalks were pulled up and taken back to the schoolhouse and left in a shed until the next lesson.

Class was back in their seats at 9:35, but I asked them to take time to jot down the facts which we had determined.

*All names omitted. Initials used do not correspond to letters in table

This field which we visited had already been husked and had yielded 64 bushels per acre.

I left the school at 10:10.

LESSON V

December 6.

Reached schoolhouse at 8:40. Asked two of the boys to go and get some stalks for the work, the best they could find. The best of these was not very good as the leaves were badly torn, otherwise it was satisfactory.

Class started at 9:05. Absences--

While I was passing the paper, pupils were sharpening their pencils. I explained briefly about drawing the entire plant, getting right proportions in regard to the length of internodes and height of ear. I went about to give suggestions. They worked much more slowly than I had expected so that the other two drawings were not even started or mentioned, and most of them did not finish the one.

One boy, J., had his well along when I called his attention to the leaf arrangement which he had represented. He had drawn them in pairs. He then started over again on a clean page.

At 9:25 all stopped drawing. Papers collected later.

LESSON VI

December 6. (Followed directly after Lesson V.)

(I wonder if we have always had corn such as this?) Most of them nodded their heads that we had. L.- "We have only had it since the Indians cultivated it." G.- "We have had it anyway since Bible times for it speaks there of corn being gathered." By this time all were in doubt. I then told them briefly about the origin of corn, as it is supposed to have been, and what corn in Bible times meant. (How could we even get such corn as this which we have from the hard flint variety which the colonists raised?) All either shook their heads decidedly that they had no idea, or showed no signs that they knew, except G., who gave an excellent answer. He was sure of his ground and was anxious to volunteer. "They must have kept picking out the best ears for seed until finally it was more like what we have now. * * * If we should pick out the poorest ears from our corn now and keep doing that, after a few years probably we would have corn nearly like what they used to raise. * * * Now we pick out the best corn for seed."

(The first thing which we see then is that there is a difference in seed and also a difference in the plants themselves. We found a good many differences or variations among the plants which we studied.) To save time, I named over some of them. (What

did you mean, G, when you said you selected good seed?) "We pick out long, rather slender, smooth ears, but some people like the ears large around so they select that kind and after a while all their corn is like that." (Different people then have different ideas of what is the best corn and select accordingly. Some people like to have the ears high up on the stalk, others like them low. How could a man get corn which had low ears?) J.- "By picking for seed the ears which grew lower on the stalk. But he would have to go and pick it before it was husked and we always take it from the wagon."

Words variation, selection and heredity written on the board. Heredity explained as the tendency of young plants to grow up into plants very like the plants from which the seed came; the tendency of young animals to be like their parents, or of children to be like their mother and father.

Assignment made for reading in Bulletin 229. I neglected to take the bulletins with me this morning but mailed them this afternoon to Mr. C.

Class closed at 9:45.

NATURE-STUDY
(1st class)

LESSON II

Reached schoolhouse at 11:30.

I could see immediately that my hopes for B. (a girl sixteen years old) had been too high.

Mr. L. had a class in 9th year literature after I got there. R., J. and B. in the class. They were reading "The Merchant of Venice". J. did practically all of the reciting but R. assisted several times. B., however, did not say a word nor did Mr. L. apparently expect her to. She sat with her head on her hand, and though she was looking at her book, I do not know whether or not she was following the lesson.

After class I asked Mr. L. if he had said anything to B. and he said he had not. He had not heard the pupils talking about it, so had not heard her reasons for refusing to do the work. I spoke about her attitude in the literature class and he said she was always that way and almost never recited.

Two boys absent as there was scarlet fever in the family.

Class began at 11:50.

I asked B. if she would come and sit with J. and she said she didn't think it would help her any in her studies, so I paid no further attention to her,- nor shall I, as I think, considering her attitude, she will not get enough from it to pay for the loss to the others.

I first looked at the note-books, and finding that they had not been worked up very well (except J.'s) I took time to give fuller instructions regarding them. All had made note of a few birds.

I asked for lists of birds seen. G.- "Sparrows and crows". H.- "Sparrows, crows, blackbirds, hawk, snow-birds, red-bird." I inquired more closely about the red-bird and his description identified it. The pupils all knew it. R. and H. said they had often seen them here in the winter time.

(Describe the snow-bird.) H.- "Just like a sparrow, kind of brown,- the size of a sparrow, but has a white bill. It has a different chirp from the sparrow." R. agreed, Ha. and G. nodded their assent. J.- "It has sort of a top-knot and I think it is more lead color than brown." I then told them the other name, slate-colored junco, and told about the white tail feathers. None had ever seen them.

(What kind of sparrows are they which you have been seeing, or is there only one kind?) G.- "Just sparrows; they are kind of brown." (Do you know the English sparrow?) R.- "They are just the same, aren't they?" All thought so. (The English sparrow is a sparrow, but there are also many other kinds.) R.- "I have heard of a field sparrow. Is that the same? And song sparrow?" I named a number of different sparrows. (They are closely related, belong to the family of sparrows,- just as we call many flowers lilies but know that there are many kinds of lilies.)

(Describe an English sparrow.) R.- "Brown, sort of streaked and the male has a black mark on the throat which the female doesn't." (Is there any advantage to the bird in having this coloring, as many sparrows do have?) None could see any, so I suggested the protection which it would be to them.

(Why are there so few birds?) G.- "The others have gone south because it is so cold here." (Why isn't it just as cold for those that are left?) H.- "Because these have warmer coats than those which left." All finally agreed that this seemed very probable, but could offer no other explanation. (Where do we see these birds now, say the sparrows and snow-birds?) R.-"Around the house or barnyard in trees." J.- "In weeds along the road." (What are they doing?) J.- "Picking up the seeds which they eat." (Does this suggest to you a reason why these birds can stay with us?) J.- "There is plenty of food for them even when the snow is on the ground." (Do you know about the swallows, martins and chimney swifts? Are there any left? Why? What do they eat? Why are they circling through the air as they usually are when we see them?) J.- "Perhaps they are catching insects." (Why have they left us?) J.- "No insects left, and they have gone south where they can get some." I told them that food was the main reason why birds left,- at least those left were ones which could secure food easily.

(How are the sparrows and snow-birds provided that they may eat seeds?) R.- "Sharp edge along bill for cracking seeds." H.- "Bill thick for breaking seeds."

Woodpecker and hawk briefly discussed in same way.
(Be on watch for more birds for there are many others which are with us in the winter.)
Ha. made no recitation. G. recited but not very enthusiastically. It seems as if she tried not to be interested but forgot herself occasionally.

Class closed 12:15.

LESSON V

December 6.
Class began at 11:40.
B., S. and C. absent.

I passed elm and maple twigs. No one knew what either was. I finally had to tell them that they were the same as we had had in the first written lesson. Ha. was the only one who could tell then what they were.

(It is evident we had better give a little attention to studying twigs for they are a means of identifying the trees. Let us examine the two twigs and discover differences.) The following differences were noted and verified:

"On the maple, two buds together on opposite sides of branch; on the elm one at a time, first on one side and then on other." I made a mis-step by suggesting the word "opposite" for the maple, and G. and J., at the same time, said that they were opposite on the elm too. I then summed up our observation by saying that buds in the elm were opposite and single, while the buds of the maple were opposite and in pairs. I here demonstrated with a string that the arrangement of buds on the elm was spiral. I had to give them the word spiral and it seemed new to them.

R.- "Difference in color of bark--lighter and smoother in maple.
Ro.- "Difference in shape of buds--shorter and more blunt in maple,- pointed and slender in elm."

J.- "Buds of elm curve toward stem." I showed them twig of Carolina poplar and ash for comparison of shape. They recognized the likeness in bud arrangement between ash and maple.

J.- "Bud at the tip of each branch of maple is much larger than others,- on the elm the tip is dead." Others found that the tip bud was sometimes present on elm but no larger and usually smaller.

Ro.- "Buds are different color; red in maple and black in elm". H. — "Gray in elm."

(What comes from these buds?) At some time they had made

a study of the year's growth of a branch so that they had a basis for their answers. No one could state the fact, but all seemed to feel that there was some relation between buds and the growth of the twig. R. alone thought flowers came from them, but he seemed to have missed the work which the others had had previously. I then told them that a twig with a number of leaves grew from each of these buds, but that sometimes flower buds were present too.

(Where were the leaves attached to the twig?) Most could find no evidence, but H. finally pointed out the leaf scar "at the butt end of the bud". I then passed a branch from a shingle oak, which still retained its leaves, to show that the leaf really was attached at the base of the buds.

Assignment made for drawings.
Class closed at 12:00.

LESSON VI

December 6. (Followed directly after Lesson V.)
B., S. and C. absent.

(We have given most of our attention to plants, but there are just as many things to be learned about the animals, even our common domesticated animals. Have there always been domesticated animals?) G., Ha. and Ro. nodded decidedly that there had been. H.- "They were wild first." J.- "I thought animals were on earth first and then when people came, they tamed some of the animals." (Which was the first to be tamed?) None knew, but Ro. suggested the cat. J. thought probably oxen. I told them the dog. (Why?) Ro.- "So they would hunt,- rabbits and things." I then told them what history knew of the domestication of the dog.

(From what were they domesticated,- do we have a wild dog today?) H.- "Wolves." (There is no animal living today which people can point to and say that from such a one our dogs were domesticated, but they do know that it was some animal very like the wolf.) (Why did those early people select the dog?) J.- "I think they lived mostly on meat of wild animals which they could catch, so they tamed dogs to help them." Ro.- "I don't see how they could catch them." R.- "Catch them when they are little."

I told them how wolves hunted in packs and how early people first owned packs of dogs--that some people still owned packs to use for hunting.

(What kind of dogs do you know and are they only used for hunting now?) R.- "Used to watch cattle and sheep--collie and shepherd." Some one suggested watch dogs and I, pets. Some of the kinds named--rat terrier, sky terrier, St. Bernard, bull dog.

Assignment--to get pictures of dogs and to think how it came about that we have so many kinds of dogs when early people had only wolf-like dogs.

Class closed at 12:20.

(These two lessons were the most successful from the point of interest of any which I have had with this class. For the first time G. gave herself freely to the work, each time before attending and answering questions but in a rather unpleasant manner. The others too seemed unusually responsive.)

FINAL TEST

As stated before, the final test was made out so that the papers could be graded on the same points as the preliminary test had been. The main part of the test was based upon a topic quite foreign to anything touched upon in the previous lessons, but the fourth question was the same as A-4 of the preliminary test. This question had never been referred to in any way since the pupils had written on it, so that it was believed that it would show very well if the pupils were able to work out the problem any better than they had been in the beginning. The questions were as follows:

2 specimens of clover seed used. 1- 98% pure. 2-40% pure.

I

(Sample of 1 given each pupil.)

Examine carefully for 3 minutes.

(Removed. Sample of 2 given each pupil.)

What is it? Tell how this differs from 1.

II

Draw a small sample of what you see.(2)

(Drawing at least twice natural size.)

III

(Pupils told what each is.)

Why would it not pay to plant 2?

Could anything be done to make it worth planting?

IV

If you were raising cotton and found that your crop was small, there being few bolls on a plant and most of these being small, what would you do to double or treble your crop within five years?

V

What of all you have learned in these lessons do you think is most useful for a farmer to know?

After the papers were collected, a few minutes were taken to make certain that the pupils derived some benefit from this study of pure and impure seed. The problem was stated, "Which is really cheaper, clover seed 98% pure at $9.00 per bushel, or seed 40% pure at $6.00 per bushel?" From the interest manifested and the amount of benefit which they got from just this short exercise, it was evident to me that this study of seeds with some identification could be very profitably conducted in the 7th, 8th or 9th grades.

The grades were based on the various questions as follows:

1. General knowledge - 1, somewhat from 3.
2. Observation - 1, 2.
3. Freedom of expression in writing - whole paper.
4. Freedom of expression in drawing - 2.
5. Reasoning - 3, 4.
6. Initiative - 3, 4, 5.

RESULTS

1. In general, the class in agriculture worked with more steady interest than the one in nature-study, but did not show much enthusiasm, the most being in connection with the corn judging and the nutrient tests. The pupils were as interested as in other work, however,

and as a class were much more enthusiastic over school work than the first class.

The first nature-study class, taught parallel to the one in agriculture, showed a decided enthusiasm at several points in the series,- the lesson on twigs, the two on dogs, as well as the corn judging and the nutrient tests. The second class in nature-study was more uniform in this respect. Both classes in nature-study as a whole were less restrained and the recitations more spontaneous than was the case with the class in agriculture.

2. Regarding one of the original questions asked,- Would the nature-study class be able to get as much from the one topic of corn in five lessons after the nine of a general character, as the other class did in the fourteen?- it seemed that they did master the main points just as thoroughly, although some of the details were not touched upon.

3. Without question, the nature-study class acquired more general knowledge, a greater variety of information, facts which opened upon more fields of thought than the agriculture class.

4. After the experiment was finished, a general review was given at the request of the county superintendent,- this to take the place of the "central" examination which he had given to all the other 7th year pupils in the county. This review showed that the 7th and 9th year pupils had the main points of the lessons very well fixed in mind, exceptionally so in some instances.

The daily work and the reviews indicated that the work as a whole was beyond the ability of the 5th grade. One or two did very well, however, and in some of the lessons, they did quite as well as some in the upper grades.

5. Comparison of the grades on preliminary and final tests. (Tables)

NATURE-STUDY

Pupil	Observation		Freedom of Expression in Writing		Freedom of Expression in Drawing		Reasoning		Initiative	
	First Test	Final Test	First Test	Final Test	first Test	Final Test	First Test	Final Test	First Test	Final Test
A	85	95	95	95	95	95	95	98	88	98
B	90	95	90	90	85	95	95	95	95	98
C	80	95	90	95	75	80	90	85	90	80
D	20	50	70	70	40	25	50	0	40	0
E.	75	90	95	95	70	90	80	95	90	98
F	90	85	95	90	70	90	95	90	98	95
G	85	85	95	95	85	80	75	90	95	95
H	50	70	80	90	75	70	90	95	90	98
I	70	85	90	90	40	70	40	70	50	80
J	80	60	85	80	80	50	50	85	70	85

Line divides the first from the second class..

AGRICULTURE

Pupil	Observation		Freedom of Expression in Writing		Freedom of Expression in Drawing		Reasoning		Initiative	
	First	Final	first	Final	First	Final	First	Final	First	Final
A	70	70	85	85	80	50	80	70	80	70
B	75	80	95	90	80	75	50	80	50	80
C	80	90	85	95	70	90	70	90	60	95
D	50	85	85	80	70	50	80	40	85	50
E	20	50	40	70	20	25	0	25	0	20
F	75	80	80	85	80	85	70	80	70	85
G	50	50	70	80	20	80	75	75	70	80
H	40	90	40	80	60	80	50	50	75	60
I	60	95	85	50	85	70	80	50	75	60
J	60	90	70	80	70	80	70	75	80	80
K	95	90	95	85	80	85	98	95	98	95
L	80	70	90	85	95	85	80	75	85	80
M	85	95	80	70	85	90	70	70	80	70
N	60	75	75	70	30	70	60	50	50	50
O	40	75	80	70	25	75	70	50	80	50
P	50	70	60	75	40	80	70	90	70	90
Q	85	70	80	60	85	80	70	80	50	85
R	60	90	70	85	30	80	70	80	70	85
S	80	70	80	70	60	60	80	70	80	60

Line divides first from second class.

since there was so much difference in the original ability of the two classes, the median of individual gains would seem to indicate most clearly any differences in results.

INDIVIDUAL GAINS

Nature-Study (Both Classes)

Observation	Freedom of Expression in Writing	Freedom of Expression in Drawing	Reasoning	Initiative
-20	-5	-30	-50	-40
- 5	-5	-15	- 5	-10
0	0	- 5	- 5	- 3
5	0	- 5	0	0
10	0	0	3	3
M (12.5)	(0)	(2.5)	(4)	(5.5)
15	0	5	5	8
15	0	10	15	8
15	0	20	15	10
20	5	20	30	15
30	10	30	35	30

First Class in Agriculture

0	-35	-30	-40	-35
0	- 5	-20	-30	-15
5	- 5	-15	-10	-15
5	0	- 5	0	-10
M 10	5	5	0	10
30	10	5	10	15
35	10	20	20	20
35	30	20	25	30
50	40	60	30	35

M= Median.

CONCLUSION

From these comparisons, there is little conclusion to be drawn in regard to the original question as to whether or not in our tendency toward the utilitarian, we are giving the child the same opportunities for development which the broader field of nature-study offers. Except that there was a decided gain in observation in both classes, the gains were so slight that, considering the difficulties encountered during the investigation, it must be said that the results are inconclusive.

SUMMARY

An experiment to determine if possible, if the child in studying agriculture has the same opportunities for development which he has in nature-study.

Experiment tried in four rural schools of the same county, three taught by myself and one (agriculture) taught by the regular teacher from the plans which I sent her.

Preliminary test given all classes.

Training series of two sorts; nature-study in two schools, closing with an economic study (corn); agriculture in two schools, one economic study (corn) pursued through the entire time. Nineteen lessons in each. Two lessons a week, averaging 27 minutes each.

Final test given to all classes.

Difficulties encountered:

1. Experiment covered a long period of time, nearly four months, due to the interference of county examinations, vacations, and my other university work.

2. Attendance was irregular, several missing preliminary

and final tests.

3. Pupils moving from districts reduced the numbers.

Not considered advisable to repeat such an investigation under these conditions.

Results are inconclusive.

SUGGESTIONS FOR FURTHER INVESTIGATIONS

1. It will be necessary to make the numbers much larger, hence the classes should be larger and attendance more regular. To accomplish this, it should be tried in a town where there are two or more ward schools.

2. Have the classes of the 7th or 8th grade, possibly 6th.

3. The work should be started sufficiently early to be completed before the close of the semester, or before promotion time.

4. Two periods a week of 25 minutes each ~~is~~ are much more desirable for classes of the upper grades, than shorter daily periods.

5. The attitude of the teacher must be considered as an important factor, for indifference or enthusiasm on his part has a direct effect upon the attitude of the pupils.

6. So far as data are concerned, little is gained by having another teach from the same plans, for it seems inadvisable ordinarily to explain that the plans are in the nature of an experiment, so he cannot appreciate the necessity of careful record of details.

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